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Forage Crops for Oregon Coast Counties

By

Albert E. Engbretson and George R. Hyslop

Vetches and oats are solving Coast forage problems.

CORVALLIS, OREGON

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SUMMARY

Dairying is the main agricultural industry of the Coast largely because of favorable climatic conditions, distance to market, and inability to use large areas of land except by pasturing.

Maintenance of a high plane of dairy production requires more legume hay, better pastures, and more succulent crops for winter feeding and to supplement summer pasture.

Choice of forage crop depends partly on the climate of the section of the Coast under consideration, whether it is to be grown on hill, bottom, or tide-land, and what manures or fertilizers may be economically applied at that place. Soil fertility is an important problem, and the use of fertilizer or manure depends on the soil type and the crop grown.

Census figures show great variability in kind of crop and in yield per acre in the Coast counties, but they show a general shortage of legume hay and in some sections a shortage of succulents.

Forage production to meet real Coast needs must provide more legumes for hay, silage, and summer succulents. Successful inoculation, lime, manure, and early planting give best results with legumes.

Common, Hungarian, and woolly podded vetches for fall sowing, and purple and common vetches for spring planting, are the best vetches. They should be sowed with oats.

Peas and oats spring planted are probably the best annual legume combination for the Coast.

Red and Alsike clover are excellent hay crops for newly cleared upland and bottom soils, and where lime and manure are available their production may be profitably continued on all well-drained soil types.

Of the grains for hay, Gray winter oats is probably best when fall sown alone or as a supporting crop for vetch.

Turnips, rutabagas, and mangels are all important—turnips for summer feeding, and rutabagas and mangels for winter use.

Mangels are grown where early planting is necessary and where the root maggot injury to rutabagas and turnips is severe.

Root crops respond to heavy applications of manure (20 tons or more an acre) and superphosphate (400 to 500 pounds an acre).

Mangels must be lifted and stored for winter feeding, while rutabagas may be fed direct from the field.

Standard root varieties are Pomeranian White Globe turnips, Improved American and Skirvings' Improved rutabagas, and Prize-winner, Mammoth Long Red, and Giant Intermediate mangels.

Green feed or soiling crops are necessary to supplement summer pasture. They produce large yields of forage on small acreages where intensive production is practiced.

Three times as much silage is grown in the south as in the north Coast section. Corn, peas-and-oats, and vetch-and-oats are used. Peas-and-oats is the best silage combination where it is too cool for corn.

Pasture improvement through new seeding and proper management will produce much new cheap forage.

Forage Crops for Oregon Coast Counties

By

ALBERT E. ENGBRETSON and GEORGE R. HYSLOP

CONDITIONS SIMILAR IN CLATSOP, TILLAMOOK, AND LINCOLN COUNTIES

The facts, suggestions, and recommendations presented in this bulletin are intended for the Oregon Coast counties and the more moist sections of Columbia county. The importance and need of the dairy industry and other conditions influencing the selection and production of forage crops are near enough alike in Clatsop, Tillamook, and Lincoln and the more moist areas of Colmbia counties that the crops and practices recommended should apply with but slight modification. In Coos, Curry, west Lane, and west Douglas counties the soil and climatic conditions vary sufficiently from those of Clatsop county that the crops and practices recommended will apply only in part. The longer growing season and lighter rainfall in some sections of these southern counties offer possibilities for other crops such as barley and corn.

Dairying the main agricultural industry. Dairying is the outstanding agricultural industry of Oregon Coast counties. The moist, mild climate and long growing season are unusually favorable for abundant rich pastures. The mild climate and long season on good pasture likewise are unusually favorable to the dairy cow and to establishing a successful dairy industry. Dairy products valued at $4,549,279.00 were produced in the six counties named in 1919, according to the 1920 Federal census. For the same year the number of cows is given as 53,612 valued at $4,064,942.00. Table I gives distribution by counties.

TABLE I. DAIRY CATTLE AND DAIRY PRODUCTS, 1920 CENSUS

County	Number of dairy cattle	Value of dairy cattle	Value of dairy products
Clatsop	5,476	$ 417,691	$ 400,728
Columbia	7,718	617,257	543,332
Tillamook	14,390	1,354,406	1,765,906
Lincoln	5,768	287,782	255,411
Coos	16,155	1,108,291	1,289,775
Curry	4,105	279,515	294,127
Totals	53,612	$4,064,942	$4,549,279

MAINTAINING THE DAIRY INDUSTRY

Dairying needs more legume hay. Liberal feeding of good legume hay is essential to high average production. As the percentage of hay that is legume increases, production increases and cost of production decreases, other things being equal. A good producing cow requires from two to three pounds daily of digestible protein to maintain production. Besides furnishing a desirable cheap protein, legume hay carries a large amount of minerals essential to health and maintenance. If the protein is withheld there is a marked decrease in milk production. If it is purchased in the form of high protein concentrates the cost is greater than in the form of legume hay, and profits are correspondingly less.

An analysis of the United States Census figures for 1919 for the hay, green forage, silage, root, and feed grain production of each of the Coast counties is shown in tables II, III, and IV. These census figures show a total production of 32,689 tons of legume hay for the Coast counties in 1919. The number of dairy cows is given as 53,612. The average yield of legume hay as given is 2.4 tons per acre. The average yield without lime or manure at the Astoria Experiment Station is about two to two and one-half tons. When lime and manure are applied the average yield is three and one-half tons. Since these yields of legume hay can be grown on the average dairy farm of the Coast counties, it would seem that the dairy industry would profit by increasing production of legume hay to at least one ton per head.

Crops for succulence are important. The aim of every successful dairyman is to try to maintain conditions as they are in the spring of the year. Production is then at its highest due to an abundance of pasture which furnishes ample green feed for production, acts as a tonic, creates a keen appetite, and is a cheap source of feed. Succulent feeds such as soiling crops, silage, and roots furnish the same things but not to the same extent. Succulent feeds for the entire year are becoming more essential every year due to necessity of maintaining production at a high level. With hay and grain this can not be done economically. During years of low summer rainfall on land having a limited pasture season, or on farms carrying the maximum number of producing cows, the use of soiling crops during summer becomes necessary. There are few sections of the country where it is as easy to provide an ample supply of succulence with or without the use of a silo. On farms where fifteen or more cows are fed during the winter a silo will prove a good investment.

TABLE II. ACREAGE AND PRODUCTION OF HAY FROM PERENNIAL GRASSES AND LEGUMES BY COUNTIES AND DISTRICTS FOR THE COAST SECTION

	Timothy		Timothy and clover mixed		Clover alone		Alfalfa		Other tame or cultivated grasses		All tame or cultivated grasses	
	acres	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*
Clatsop	80	132	2154	5453	199	405	13	40	848	1839	3294	7869
Columbia	353	769	3149	7274	942	2263	101	336	1496	3314	6041	13956
Lincoln	212	424	1288	2454	447	868	11	26	2204	3522	4162	7294
Tillamook	36	83	1153	3180	113	263	32	36	6231	12359	7565	15921
North Coast total	681	1408	7744	18361	1701	3799	157	438	10779	21034	21062	45040
Coos	48	29	1262	3173	1124	2914	35	74	3665	8784	6134	14974
Curry	1	1	25	51	437	1121	95	280	1523	3214	2081	4667
South Coast total	49	30	1287	3224	1561	4035	130	354	5188	11998	8215	19641
Coast total	730	1438	9031	21585	3262	7834	287	792	15967	33032	29277	64681

TABLE III. ACREAGE AND PRODUCTION OF HAY FROM WILD GRASS, SMALL GRAIN, AND ANNUAL LEGUMES AND OF SILAGE, GREEN FORAGE, AND ROOT CROPS, BY COUNTIES AND DISTRICTS FOR THE COAST SECTION

	Wild salt or prairie grass		Small grains cut for hay		Annual legumes cut for hay		Silage crops		Corn cut for forage		Kafir sorghum, etc., for forage		Root crops for forage		Hay and forage total	
	acres	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*	*acres*	*tons*
Clatsop	423	781	768	1642	150	403	46	356	.....	.....	2	6	180	4665	4863	15722
Columbia	2250	2631	2031	3999	165	472	546	4304	111	605	31	323	228	2281	11403	28571
Lincoln	476	709	3274	5912	182	334	216	1186	91	322	15	45	285	4317	8701	20119
Tillamook	882	1772	2050	4738	151	68	185	1330	12	76	.....	.....	149	2356	10994	26261
North Coast total	4031	5893	8123	16291	648	1277	993	7176	214	1003	48	374	842	13619	35961	90673
Coos	131	261	6020	14967	342	1068	2543	22120	437	2546	9	26	539	13937	16155	69899
Curry	87	133	2011	4715	37	133	142	1315	189	1024	.....	1	82	1780	4629	13768
South Coast total	218	394	8031	19682	379	1201	2685	23435	626	3570	9	27	621	15717	20784	83667
Coast total	4249	6287	16154	35973	1027	2478	3678	30611	840	4573	57	401	1463	29336	56745	174340

TABLE IV. ACREAGE AND PRODUCTION OF FEED GRAINS BY COUNTIES AND DISTRICTS FOR THE COAST SECTION

	Corn		Wheat		Oats		Barley		Rye		Mixed grains		Total	
	acres	*bu.*	*acres*	*bu.*	*acres*	*bu.*	*acres*	*bu.*	*acres*	*bu.*	*acres*	*bu.*	*acres*	*bu.*
Clatsop	2	83	81	2818	534	25925	7	200	.....	.....	.....	.....	624	29026
Columbia	3	80	1315	33003	2314	107988	176	6194	52	1277	86	2916	3946	151458
Lincoln	36	1115	444	6331	963	35643	11	235	31	345	4	67	1489	43736
Tillamook	None		None		None		None		None		None		None	
North Coast total	41	1278	1840	42152 mainly Columbia	3811	169556	194	6629	83	1622	90	2983	6059	224220
Coos	293	10775	184	4277	470	20890	556	31262	11	266	22	325	1536	67795
Curry	74	2398	30	444	112	4744	62	2299	3	12	.....	.....	281	9897
South Coast total	367	13173	214	4721	582	25634	618	33561	14	278	22	325	1817	77692
Coast total	408	14451	2054	46873	4393	195190	812	40190	97	1900	112	3308	7876	301912

According to the 1920 census figures, 64,921 tons of silage and roots were produced in the Coast counties to feed 53,612 dairy cows, or 1.21 tons per head. Because of the difficulty of curing hay the dairy ration should contain a large amount of succulence. Experience at the Astoria Station shows that at least two and a half tons of succulence per cow should be fed during the winter, October 15 to April 15. This amount can profitably be increased to four tons for each producing cow.

Pasture maintenance vital. Most of the dairy products of the Coast counties of Oregon are produced while the cows are on pasture. In Clatsop county approximately 61 percent is produced during the pasture months and 39 percent during late fall and winter months, part of this being produced from pasturage. The pasturage months are the most profitable as there is very little cash outlay for feed. In view of these facts the importance of pasturage can not be over estimated. It is generally true that after once established very little care is given pastures to maintain them or to increase their production. It is not a general practice to rotate pastures or to reseed when they begin to run out. Much of the pasture land is in such shape that it is impossible to do any pasture improvement other than reseeding until it has been leveled and cleared. The first step in pasture improvement is to put the land in such condition that it can be handled when there is need.

SOIL AND CLIMATE IMPORTANT IN SELECTING FORAGE CROPS

For the purpose of this bulletin, hill land, bottom-land, and tide-land soil types are considered, and only limiting factors of climate are important here.

Hill land. The hill land has not been held in high favor due to low fertility when cleared but this class of land must be looked to for expansion of the dairy industry in the future.

Most of the hill land originally is timbered. It is gently sloping to rolling or steep; compared with tide-land, it is low in fertility when first cleared. The upland soil is easy to work and responds readily to fertilizers. With proper cropping and fertilizers for four or five years it will produce as much of any forage crops except pasture as tide-land or bottom-land. The necessary improvement and maintenance of fertility can be managed without difficulty on a dairy farm by proper care and use of manure.

Tide-land. The tide-land is level but is cut up by sloughs, and contains more or less logs and roots. It is rather difficult to put in shape for cultivated crops. The soil contains a large amount of organic matter and produces an abundance of grasses and clovers after the land has been slashed and burned. This production continues as long as there is an abundance of organic matter. For pasture the high production will continue perhaps ten or fifteen or more years and then the clover thins out and the pasture is not so good. Cultivated crops remove the organic matter more rapidly. In about eight or ten years the crop production is considerably reduced unless soil fertility is improved. The problem then is much the same as for the upland.

The tide-land soil is naturally best suited to pasture but if well drained and cultivated it will produce good yields of a variety of forage crops.

Bottom-land. The bottom-land occurs along streams and is subject to overflow. It has a greater and more lasting fertility than either the tide-land or the hill land. All forage crops suited to the Coast section grow well on the bottom-land. The soil structure, fertility, and abundant moisture are favorable to the finest of pasture. White clover and the better pasture grasses grow in abundance. This land, like all others, has its limits, however, and there is a problem of pasture maintenance, especially where the lands are not subject to periodical overflow.

Soil fertility an important problem. For the Coast section soil fertility is perhaps the most important factor in determining yield and quality of forage. Fertility becomes a problem sooner or later on each class of land. On the upland it is an immediate problem when the land is cleared. The tide-land and bottom-land are most productive when first reclaimed and the need of fertilizers comes later.

No other fertilizer has proved as valuable as barnyard manure. On the dairy farm proper care of the manure to prevent leaching, and its wise use on the land, will go a long way toward building and keeping up soil fertility and insuring good yields of forage with a minimum of weeds. Concrete gutters, bedding, and manure pits should be found on every modern dairy farm as the first essentials in maintaining fertility and satisfactory crop yields.

Certain commercial fertilizers are valuable to supplement manure for most profitable yields of some crops. Fertilizers for each crop are recommended in the crop discussions.

Climatic factors. The climate of the Coast counties is characterized by high annual rainfall; long, cool growing season; and mild winters. The precipitation varies from about sixty inches to over one hundred inches annually.

The heavy winter rains are a factor in reducing soil fertility especially of hill lands. For the period July 1 to September 1 the lack of rain in some years causes a shortage of pasturage and reduction in milk production. Accurate data for three years at the Astoria Station show that spring-freshened cows decreased in milk production 25.8 percent during this period.

Winter temperatures rarely drop below 20 degrees F. A light frost, however, causes the hill land to heave and in years of continued freezing and thawing even the hardy vetches winter-kill. This difficulty is slightly less on the tide-land and bottom-land. This factor is not a serious one but influences the selection of the crop and the cropping practices. Limited tests indicate that drilling to a depth of two inches rather than broadcasting may largely overcome the difficulty.

Recommendations are based upon experiments and experience. The growing need for more information on these and other problems was in

mind when the John Jacob Astor Branch Agricultural Experiment* Station was established near Astoria, in Clatsop county, Oregon. This station is provided with about forty-five acres of typical tide-land and about ten acres of average hill land soil. This land was set aside for experimental work in 1913. Clearing and improvements were begun that year. Experiments with crops and soils were started in 1914 and have been continued and expanded as new land could be cleared and put in shape for cultivation. A dairy herd of fifteen to thirty head has been maintained since 1914.

The crops and practices recommended in the following pages are the result of experiments at the Experiment Station and observations of needs and practices on farms under similar conditions. They have been used successfully in providing for the station dairy herd, and most of the recommendations have been tried with good results by at least a few dairy farmers. It is believed that more dairy farmers could profit by adjusting their farming practices along the lines recommended.

COAST CROP PRODUCTION SHOWN BY CENSUS FIGURES

United States census statistics for the year 1919 show clearly the forage cropping practices of the Coast sections. For convenience the Coast has been divided into the north and south group of counties. The north includes Clatsop, Columbia, Lincoln, and Tillamook. Columbia county has much land resembling Coast conditions as well as a large interior area where grain is grown. The south group includes Coos and Curry counties. Since the statistics for the Coast sections of Lane and Douglas counties cannot be segregated, they are omitted entirely. Table V gives the crop production by these groups.

*The John Jacob Astor Branch Experiment Station was established by Act of the Legislature in 1913 (Chapter 228, Oregon Laws, 1913) for the purpose of investigating and demonstrating the agricultural possibilities of reclaimed swamp and logged-off lands. In accordance with a provision of the Act, Clatsop county provided approximately seventy acres of land and the necessary buildings, improvements, and initial equipment. The land acreage was later reduced to the present area of about 55 acres. From time to time Clatsop county has contributed additional assistance toward clearing and improvements. The Act establishing the station provides an annual state appropriation of $3000 for maintenance and operation, and places the station under the control and management of the Board of Regents of the State Agricultural College. The tide-land was diked in 1913, and since that time slashing, clearing, leveling, and improving both the tide-land and the hill land has involved so much time and expense that it has retarded experimental work. The crops now grown annually on both hill land and tide-land stand as a convincing demonstration of the value of these lands.

Part of the data on vetches and grasses reported herein were secured at the Astoria Station in cooperation with the Office of Forage Investigations of the United States Department of Agriculture.

TABLE V. ANALYSIS OF OREGON COAST CROPPING PRACTICES BASED ON U. S. CENSUS OF 1919

North counties—Clatsop, Columbia, Lincoln, Tillamook.
South counties—Coos, Curry.
West Lane and Douglas omitted because of inability to segregate Coast data from county statistics.

Crop	North Coast		South Coast		Total	
	acres.	*tons*	*acres*	*tons*	*acres*	*tons*
Annual legumes cut for hay	648	1277	379	1201	1027	2478
Timothy and clover	7744	18361	1287	3224	9031	21585
Clover alone	1701	3799	1561	4035	3262	7834
Alfalfa	157	438	130	354	287	792
Total legume and legume and timothy	10250	23875	3357	8814	13607	32689
Small grains cut for hay	8123	16291	8031	19682	16154	35973
Timothy	681	1408	49	30	730	1438
Other tame or cultivated grasses	10779	21034	5188	11998	15967	33032
Wild salt or prairie grass	4031	5893	218	394	4249	6287
Total grass	23614	44626	13486	32104	37100	76730
Corn cut for forage	214	1003	626	3570	840	4573
Sorghum kafir for forage	48	374	9	27	57	401
Silage crops	993	7176	2685	23435	3678	30611
Root crops	842	13619	621	15717	1463	29336
Total succulents	2097	22172	3941	42749	6038	64921
Small grains including corn for grain	6059*	224220*	1817	77692	7876*	301912*

*Probably 2,600 acres and 100,000 bushels too high on account of non-coast part of Columbia county.

TOO LITTLE LEGUME HAY

The north Coast district grows more legume hay than the south Coast although the acreage of legume hay in both sections is far too small.

Grass hay predominates. As contrasted with the total of 13,607 acres of legumes including 9,031 acres of timothy and clover mixed, there are 37,100 acres, or nearly three times as much, grass hay. Much of this should be replaced by legumes.

Legumes best yielders. The figures show an average yield of 800 pounds an acre more hay from legumes and mixed legumes and grass, than from the grass and grain hay. Table VI shows the average yield per acre by crops.

TABLE VI. AVERAGE YIELD PER ACRE OF COAST LEGUMES AND GRASS AND GRAIN HAY 1919

Crop	Acre yield
	tons
Annual legumes (vetch, peas, with or without oats)	2.41
Timothy and clover	2.39
Clover	2.40
Alfalfa	2.76
Legume—Average total acres and tonnage	2.40
Small grain (mostly oats)	2.23
Timothy	1.97
Other tame or cultivated grass	2.07
Wild grass (mostly swamp hay)	1.48
Grass and grain—Average total acres and tonnage	2.00

More green feeds and root crops advisable. An outstanding advantage of Coast land agriculture is its succulent pasture which can be liberally supplemented with green feeds, root crops, and silage. A study of Table V shows that the north Coast section grows relatively little silage. The south Coast grows three times as much. The north Coast grows more acres of roots, but the south Coast harvests a larger total tonnage from fewer acres.

Economical forage the Coast problem. Efficient economical forage production is the Coast cropping problem. The survey in Table V shows the need for more legumes in the cropping system. The dairy industry would profit by more green feed, silage, and root crops to supplement pasture and maintain high production.

Results at the Astoria Station show a number of successful legume crops well suited to Coast cropping systems.

Fig. 1. Clatsop county's first successful field of vetch on upland. Astoria Station July, 1916.

LEGUMES MUST BE INOCULATED

The Coast counties must grow more legume forage. Figure 1 shows the first successful stand of vetch on the upland in Clatsop county. Success with legumes hinges largely on successful inoculation. Successfully inoculated fields grow legume plants with many small enlargements, or knots, called tubercles or nodules, on the roots. Legume plants having these nodules on the roots are able to secure a considerable part of the plant food, nitrogen, from the air. Plants that are not inoculated do not have these nodules, and they usually die early and do not make a successful crop. The nodule growth on the roots is caused by special kinds of bacteria often called legume bacteria, and a field or a lot of seed is said to be inoculated when these bacteria are present naturally or have been introduced. The process of putting these bacteria on the seed or into the soil of a field is called inoculation.

Methods of Inoculation

Inoculated soil. Two general methods are used. Probably the surest method is to take surface soil from an inoculated field and scatter it thoroughly over the new field to be inoculated and harrow it in. It is best to use moist soil from the surface foot at 400 or more pounds an acre and to distribute it on a cloudy day or toward evening and get it harrowed in so the sunlight will not destroy the bacteria.

Pure culture. Another good method is to secure pure culture from the Bacteriology department of the Experiment Station at Corvallis, Oregon, and apply it to the seed. The bacteria are grown in the laboratory and are sent out in small bottles, each of which contains enough to inoculate the seed for two acres. This material costs fifty cents a bottle or at the rate of twenty-five cents per acre. It should be put on the seed just previous to planting as excessive drying seems to kill many of the bacteria.

Secure right bacteria for each legume. Since different bacteria inoculate different legume crops it is necessary to get the right kind for each crop, as successful inoculation for clover will not work on vetch or vice versa. Different bacteria are needed for the different crops, and some seem to thrive under more sour soil conditions than others. It has been found that with clover and vetch particularly, better inoculation and better production are secured if lime and manure are used on the field to be inoculated. This usually results in a good crop of vetch or clover with the first sowing.

PEAS, VETCHES, AND CLOVERS

Field peas, common, purple, and woolly podded vetch planted with oats have given very good results and are probably the best annual legumes for all-round feeding purposes. Peas and purple vetch are probably best for spring sowing and the common and woolly podded vetch for fall sowing.

Peas

Peas almost sure crop. Peas spring planted, while often at a little greater seed expense, are probably the easiest to grow and are surer of a large yield than any of the other legumes, whether fall or spring planted.

Peas have been the most certain of the spring-planted annual legumes, and are suited to most types of tillable lands of the Coast section.

Manure pays on peas. Data on soil treatment for peas is limited. Superintendent H. R. Taylor in his report for 1918 said with reference to fertilizers and manure on peas on hill land: "The application of manure proved to be of greater benefit than any of the commercial fertilizers." On old land the use of barnyard manure assures a much larger tonnage of peas. In a single-year trial in 1918 no gain was secured through the use of lime and but little was secured through superphosphate applications.

Blue Prussian good variety. Observations on growth and suitability indicate that of the varieties readily available and that have been grown

on the station, Blue Prussian is best. The White Canadian is also a good variety though somewhat earlier and shorter. Usually peas are planted with oats as a supporting crop.

Early sowing necessary. Peas to be successful must be sowed early. Table VII shows a loss of about a ton an acre a month with delayed sowing.

TABLE VII. TIME OF PLANTING PEAS AND OATS AT ASTORIA STATION IN 1919

Date of planting	Yields in tons an acre
March 14	10.45
April 15	9.60
May 10	8.65

Data at other experiment stations and field observations show that one of the most important factors in success with field peas is *early planting.*

Use plenty of seed. Ninety to 120 pounds of peas with about 50 pounds of oats is the usual sowing for one acre. When drilled with a grain drill 90 pounds of peas are enough. When broadcasted and disked in, 120 pounds should be used.

Early-planted peas and oats are ready to cut for green feed in mid July. Peas and oats are ready for hay when the pods are about half formed or when the oats are in a soft dough stage. Well cured pea and oat hay is very palatable and readily yields 3½ to 4 tons an acre under good conditions.

Pea silage good. Pea-and-oats silage is one of the best silage crops for the north Coast district. The average yield at the Astoria Station was 9.53 tons an acre. Both peas-and-oats and peas-and-barley offer great promise in the warmer south Coast sections, especially where corn silage is not successfully grown.

Peas-and-oats is ready for siloing when in a hard dough stage. Cutting fresh, to short lengths, good packing, and just enough water to exclude air, makes a high-class silage. Care must be exercised not to add too much water to silage in the Coast section; for this reason short cutting and thorough packing are important.

Vetches

Inoculation important. Common vetch is grown to some extent in most Coast counties. Success with it has been variable largely because of difficulty in getting the vetch inoculated. The usual farm experience with vetch has been to plant it one year without success, then replant it on the same land the next year with varying degree of inoculation secured, then replant and get a successful crop with good inoculation. Experiment Station work has proved that vetch on manured land is more easily inoculated and makes good yields.

Liming of inoculated land or the use of lime and manure together with inoculated seed gets successful inoculation of the common vetches the first crop.

Manure and lime help. Manure alone, lime alone, and especially lime and manure have given increased yields over similar land unlimed. Tables VIII, IX, and X show the benefit of manure, lime, and lime and manure on a series of plots in the fertilizer trial on the hill land.

TABLE VIII. EFFECT OF MANURE ON YIELD OF VETCH FOR HAY IN TONS AN ACRE

Astoria Experiment Station 1922

Treatment per acre	Hay per acre		
	No manure	Manure at 10 tons per acre	Gain from manure
	tons	*tons*	*tons*
Check, no treatment	1.95	2.00	.05
Lime 3 tons	3.00	3.32	.32
Lime 2 tons, superphosphate 160 lbs.	2.20	2.92	.72
Lime 2 tons, potassium chloride 160 lbs.	2.91	3.41	.50
Superphosphate 160 lbs., potassium chloride 160 lbs.	1.67	2.75	1.08
Check, no treatment	1.15	1.90	.75
Sodium nitrate 160 lbs.	2.62	2.93	.31
Superphosphate 300 lbs.	1.17	2.20	1.03
Potassium chloride 160 lbs.	1.80	2.52	.72
Sulfur 200 lbs.	1.80	2.70	.90
Check, no treatment	1.55	2.27	.72
Average gain	1.98	2.63	.65

TABLE IX. EFFECT OF LIME ON YIELD OF VETCH FOR HAY

Astoria 1922

	Hay per acre
	tons
Average 3 limed plots	2.70
Average 3 unlimed plots	1.55
Gain for lime	1.15

TABLE X. EFFECT OF LIME AND MANURE ON YIELDS OF VETCH FOR HAY

Astoria Station 1922

	Hay per acre
	tons
Average 3 plots limed and manured	3.23
Average 3 plots no lime or manure	1.55
Gain for lime and manure	1.68

Purple vetch promising. In the north Coast section common vetch is the most generally grown. In the south Coast, purple vetch spring planted is very successful. Experience on the Astoria Station and in the south Coast and north Coast sections on farms indicates that purple vetch is more easily inoculated than the common vetch. Farm reports indicate that it is highly prized for spring sowing for hay in Coos

county. Fig. 2 shows excellent growth of Purple vetch with oats on the station.

Woolly podded vetch, hairy vetch, and Hungarian vetch, and certain mixtures have done well in some trials.

Fig. 2. Purple vetch and oats spring planted for green feed on hay.

TABLE XI. RESULTS OF VARIETY TRIALS OF VETCHES AND OATS SPRING PLANTED ON MANURED, OLD LAND

Astoria, 1923

	Silage, yield an acre
	tons
Tangier peas and Shadeland Climax oats	11.97
Common vetch 18805 and Shadeland Climax oats	10.20
Hairy vetch and Shadeland Climax oats	9.85
Common vetch and Shadeland Climax oats	9.21
Common vetch and Gray Winter oats	8.82
Purple vetch and Gray Winter oats	6.42

TABLE XII. RESULTS OF VARIETY TRIAL OF VETCH AND GRAY WINTER OATS, FALL SOWN

Astoria 1923

	Silage, yield an acre
	tons
Common vetch and Gray Winter oats	7.55
Woolly podded vetch and Gray Winter oats	7.43
Common vetch 13430 and Gray Winter oats	6.90
Hungarian vetch and Gray Winter oats	6.89
Pearl vetch and Gray Winter oats	6.26

Fall or spring sowing? Vetches are either fall or spring planted. Where serious freezing and thawing does not take place fall sowing is probably best. At Astoria only the hardiest varieties survive some of the winters. Table XIII gives available data on fall and spring sowing of Common vetch and oats. The table shows the superiority of planting spring oats rather than winter oats with vetch in the spring.

TABLE XIII. RESULTS OF SOWING COMMON VETCH WITH OATS IN FALL AND IN SPRING AT ASTORIA

	Yield an acre				
	1918 Hay	1919	1921	1922	1923
		Silage			
	tons	*tons*	*tons*	*tons*	*tons*
Fall sown Common vetch with Gray Winter oats	.....	14.10	Failed	6.08	7.55
Spring sown Common vetch with Gray Winter oats	2.28	.....	.....	.....	8.82
Spring sown Common vetch with spring oats	3.00	9.25	.....	.....	9.21

Hardy vetches. The following vetches are listed in the order of their hardiness as determined by a two-year trial at Astoria. Hairy, woolly podded, Hungarian, and common vetch are safe for fall planting, Purple vetch, Tangier peas, and Pearl vetch are too tender for fall sowing.

Vetch is a good spring-planted forage, but it is probable that peas give a better yield and are more easily grown on many unlimed lands. Peas are safely planted later than vetch. Table XIV compares spring-planted peas and common vetch.

TABLE XIV. RESULTS FROM PLANTING PEAS AND OATS AND COMMON VETCH AND OATS IN THE SPRING

Astoria

	Yield an acre		
	1918 Hay	1919 Silage	1923 Silage
	tons	*tons*	*tons*
Peas-and-oats	3.15	9.6	10.10
Vetch-and-oats	3.00	9.25	9.21

Vetch culture. Vetch and oats when fall planted are usually drilled in at about 60 to 80 pounds an acre with from 40 to 50 pounds of gray winter oats. In the south Coast section red rust-proof oats are often

preferred to the gray winter. Fall sowing should take place in late September or early October.

Similar rates of sowing are used in the spring. Early sowing, in late February or early to mid March, is preferred. Spring oats, such as Shadeland Climax or Victory, are very good oats for spring sowing with the vetch. It is probable that in the warmer south Coast section the early spring sowing is of still greater importance.

Where drilling and early planting is practiced smaller rates of sowing may be used. Late sowing requires more seed per acre. The same

Fig. 3. Oats is the best grain to support the heavy growth of vetch.

is true of broadcasting. It is thought that there is less winter killing with drilled than broadcasted seed.

Oats best supporting crop. In the Coast sections where vetch makes such a rank growth as shown in Fig. 3, it is necessary to plant some supporting crop—usually a cereal. Probably the best all-round crop considering yield, hay value, and supporting power is oats. Wheat is sometimes used but is not so generally satisfactory. Horse beans offer some promise as a supporting crop for spring-planted mixtures for

silage, but there is not enough experience with them at the Astoria Station to recommend them for hay or green feed mixtures.

Time of harvesting. Vetches are ready for hay when the lower pods are about half filled or when the supporting crop is in the late milk stage. For silage the crop may be put in when the lower pods are well filled, but the seeds still in the soft dough. The quality of vetch hay and silage is not so good when there is ripe seed present. The seed is especially objectionable in the hay.

Well-cured vetch is a high-class dairy hay. It makes excellent green feed and silage and in sections where winter killing does not take place is probably the best annual legume forage.

Clovers

Life of clover. Red and alsike clovers are the most important of the moderately long-lived hay legumes of the Coast. The crop is usually easy to start on new land after it has been burned over. Many sections have difficulty reestablishing a stand afterward, probably because of insufficient lime in the soil for proper maintenance of inoculation. Stands of clover deteriorate rather rapidly without lime or manure, or lime and manure.

Weeds and grasses take the place of the clover.

Table XV shows clover survival on the fertilizer trial.

TABLE XV. EFFECT OF FERTILIZERS ON THE SURVIVAL OF CLOVER AT ASTORIA

Fertilizer treatment	Percent of clover stand remaining — Without manure — 1 year after sowing		2 years after sowing	With 10 tons manure — 1 year after sowing		2 years after sowing
	1920	1923	1921	1920	1923	1921
Check, no treatment	25	60	17	50	50	25
Lime 3 tons per acre	65	60	33	65	50	23
Lime 2 tons, superphosphate 160 lbs.	40	50	33	60	60	33
Lime 2 tons, potassium chloride 160 lbs.	35	60	30	65	50	40
Superphosphate 160 lbs., potassium chloride 160 lbs.	45	55	30	70	55	40
Check, no treatment	45	50	12	65	60	30
Sodium nitrate 160 lbs.	40	40	20	60	45	27
Superphosphate 300 lbs.	40	40	10	60	45	20
Potassium chloride 160 lbs.	25	45	....	55	45	10
Sulfur 200 lbs.	35	40	10	60	50	25
Check, no treatment	40	45	15	60	45	25
Average	40	49.5	19	61	50.5	27
Average 1 year from sowing	44.8			55.8		

The survival on manured plots is greater for both the first and second years after sowing.

Manure and lime help. There is less difference between manure and no manure in the stand where lime is used. The clover stand the second year from sowing is also much better where lime is used. Especially where manure is used there is less difference between limed and un-

limed plots. Both lime and manure are helpful in securing and maintaining a stand of clover. No other fertilizers tried seem to be worth while in maintaining clover stands at Astoria. Table XVI shows this clearly.

TABLE XVI. EFFECT OF LIME ON SURVIVAL OF CLOVER AT ASTORIA

	Percent of clover remaining on land					
	--Without manure--			---With manure---		
	1 year after sowing		2 years after sowing	1 year after sowing		2 years after sowing
	1920	1923	1921	1920	1923	1921
Average 3 limed plots	47	56.6	32	63	53.3	32
Average 8 unlimed plots	37	47	14	60	49.4	25
Difference in favor of lime	10	9.6	8	3	3.9	7

Sowing clover. Clover is usually planted in the Coast districts either alone or with a grain or hay crop in the spring. Fall-planted clover is often heaved out and killed by alternate freezing and thawing. Unless the rooting system is well established the crop is likely to be killed. After the first sowing, lime or manure, or lime and manure, is often necessary before the stand can be renewed.

Twelve pounds of red clover or eight pounds of alsike per acre is the usual rate of sowing.

The red clover is best suited to the well-drained bottom-lands and other of the soils not too sour. Alsike is best for the sour hill and tideland soils. A mixture of about nine pounds of red clover with three pounds of alsike is good for mixed land.

Tested seed best. Seed of the clover should be tested for purity and germination before purchase and sowing. Two-ounce samples carefully taken to represent the lot may be sent to the Seed Laboratory at the Oregon Agricultural College, Corvallis, Oregon, where the tests are made free of charge. Inoculation of clover in the Coast section is usually unnecessary since Coast soils are often inoculated naturally. This is probably due to the native clover growth in many sections. Where the native clover does not grow, the seed of the first sowing of clover should be inoculated. Culture for this purpose may be had at low cost from the Experiment Station at Corvallis.

Clover-timothy mixture good. Clover is sometimes sowed with timothy, especially in the north Coast section. This sowing is usually made in the spring with a nurse crop, using eight pounds of timothy with three pounds of alsike or eight pounds of red clover. For temporary sowing English rye-grass at 15 pounds is very good. The mixture of grass with the clover, especially on limed and manured land, maintains the productiveness through a longer period and helps prevent such serious falling or lodging of the clover. A high percentage of legume in the mixture is desirable. Fig. 4 shows an excellent hay crop of alsike clover and timothy on the Astoria station.

Clover is one of the cheapest and best of the hay crops to produce. It is ready for hay when just past full bloom and reaches this stage at a fairly dry time in the Coast sections.

Better yields from manure and lime. Extensive trials have been made showing the effect of fertilizers on yields of clover hay. Lime and manure not only bring about a higher percentage of clover in the stand but also result in better yields of better hay. Table XVII shows effects of lime and manure on hay yield.

TABLE XVII. EFFECT OF LIME ON YIELD OF CLOVER HAY IN TONS AN ACRE

Astoria, 1920, 1921, and 1923

	tons
Average 6 plots 3 years limed	3.25
Average 16 plots 3 years unlimed	2.79
Gains from liming	.46

Fig. 4. Timothy and plenty of alsike clover make a good hay mixture.

TABLE XVIII. EFFECT OF FERTILIZERS AND MANURE ON YIELD, IN TONS AN ACRE OF CLOVER HAY

Astoria 1920, 1921, and 1923

Treatment per acre	3-year average No manure	3-year average Manure at 10 tons an acre	Gain from manure
	tons	*tons*	*tons*
Check, no treatment	2.44	2.39	— .05
Lime 3 tons	2.85	3.85	1.00
Lime 2 tons, superphosphate 160 lbs.	2.65	3.58	.83
Lime 2 tons, potassium chloride 160 lbs.	2.88	3.35	.47
Superphosphate 160 lbs., potassium chloride 160 lbs.	2.73	3.58	.85
Check, no treatment	2.17	3.58	1.41
Sodium nitrate 160 lbs.	2.39	3.49	1.10
Superphosphate 300 lbs.	1.87	3.61	1.74
Potassium chloride 160 lbs.	2.08	3.33	1.25
Sulfur 200 lbs.	2.46	3.54	1.08
Check, no treatment	2.28	2.99	.71
Average	2.44	3.39	.95

TABLE XIX. EFFECT OF SUPERPHOSPHATE ON YIELD IN TONS AN ACRE OF CLOVER HAY AT ASTORIA

	tons
Average 6 plots 3 years with superphosphate	3.00
Average 16 plots 3 years without superphosphate	2.88
Gain	0.12

Superphosphate appears of little value for clover. The gain from superphosphate was negligible as is shown by Table XIX. Clover is also a valuable green feed crop and in some sections when mixed with grass is used for silage. Generally it is preferred for hay or green feed and vetch or peas-and-grain is used for silage purposes. Table III shows clover to be the highest yielding of the common hay plants of the Coast region. More should be grown.

Alfalfa acreage limited. Alfalfa is at present of small importance in Coast agriculture. Little experimental work has been done with it. It is probable that it is not so well suited to general Coast conditions as peas, vetch, and clover. Present indications are that its culture is not practicable except on deep, well-drained, mellow, warm bottom soils.

Sweet clover seems to offer less promise than alfalfa since its life is so short and it is only suited to conditions similar to those required for alfalfa.

GRAINS AND GRASSES FOR HAY

Experiments were begun on the tide-land to determine the best grasses for hay. Present results indicate timothy and meadow-foxtail to be the best grasses for the tide-land.

Oats best forage cereal. A trial of grains was made for hay in the spring of 1923. General practice of the Coast section is confirmed by results shown in Table XX that oats is the best grain for general Coast use for green feed or hay.

TABLE XX. COMPARISON OF SPRING-SOWN WHEAT AND OATS FOR HAY AT ASTORIA, 1923

	Hay an acre
	tons
Jenkin Club wheat	2.73
Shadeland Climax oats	3.99
Gray Winter oats	4.15

GRASS FOR GREEN FEED

Japanese barnyard millet is an excellent late summer green feed for the Coast districts. Depending on time of sowing, it is ready for feed from July to October. It is usually planted at 25 to 30 pounds an acre on well-manured land from the middle of April to late June. It sometimes yields as much as eight tons an acre of green feed at a cutting, and on rich bottom-land there may be as many as three cuttings a year

from a single sowing. It is broadcasted and harrowed in or is sowed with a drill. While the green feed quality is good, Japanese barnyard millet is not so highly prized for hay.

ROOTS

Root crop production is a distinctive feature of Coast land agriculture. Like intensive farming conditions of northwest Europe, the Coast region, of small cereal acreage, grows enormous quantities of roots. The principal roots grown are rutabagas, mangels, and turnips, though some carrots are grown in the south Coast section.

What kind of roots? There is a preference in the north Coast for rutabagas, probably because of general success in production and because they keep well in the row during the winter. In the south Coast section mangels offer more promise. Turnips are more generally used for summer and early fall feeding, while rutabagas and mangels are fed during winter and early spring. Both leaves and roots are fed to stock when fed directly from the field.

For rather dry sections requiring early planting or where the root maggot is serious on rutabagas, mangels are recommended as the main root crop.

TABLE XXI. COMPARISON OF ROOT TYPES ON UPLAND. ASTORIA, 1923

	Yields an acre — Average of all varieties of each root grown.		
	Turnips 5 plots	Rutabagas 8 plots	Mangels 9 plots
	tons	*tons*	*tons*
Roots	20.66	20.26	17.83
Leaves	8.41	5.03	6.90
Total	29.07	25.29	24.73
Roots only of the highest yielding variety	23.25	21.95	26.00

Standard root varieties. Good varieties of roots for the north Coast district are Pomeranian White Globe turnip, Improved American Purple Top and Skirvings Improved rutabagas, and Prizewinner, Mammoth Long Red, and Giant Intermediate mangels. The Pomeranian White Globe turnip is especially prized because of yield and long feeding period without becoming pithy.

Tables XXII, XXIII, and XXVII give the results of root varietal trials of 1923. Owing to inability to secure good seed, the Pomeranian White Globe turnips were not included in the 1923 trial.

Turnips

TABLE XXII. RESULTS OF TURNIP VARIETY TRIAL IN TONS AN ACRE
Astoria, 1923

Variety	No. of plots	Roots	Tops	Total
		tons	*tons*	*tons*
Imperial Green Globe	2	21.65	9.72	31.37
Green Top Aberdeen	1	20.60	6.90	25.50
Hardy Round Green	1	19.74	8.46	28.20
Cow Horn	1	19.67	7.27	26.94

Turnip culture. Turnips should be planted about June 20 in rows 30 inches apart and using 2 to 3 pounds of seed an acre. In about a month they are thinned to single plants about 12 inches apart in the row. Late planting avoids much injury from root maggots. It also helps in the eradication of spurry and other weeds. Clean culture should be given. Turnips should be fed in the fall and early winter before they become pithy.

TABLE XXIII. RESULTS OF RUTABAGA VARIETY TRIAL IN TONS AN ACRE

Astoria, 1923

Variety	No. of plots	Roots	Tops	Total
		tons	*tons*	*tons*
American Purple Top	1	21.92	4.58	26.50
Bangholm Grant	1	21.55	6.65	28.20
Improved American Purple Top	2	21.15	3.50	24.65
Skirvings Improved	2	19.57	6.47	26.04
Magnum Bonum	2	18.10	4.55	22.65

Fig. 5. Improved American Purple top rutabagas fertilized with manure and superphosphate.

Rutabagas

Improved seed needed. There is no constant difference between American and Improved American Purple Top rutabagas. Both of these and Skirvings Improved have done well through many years at Astoria. Fig. 5 shows a heavy crop of rutabagas.

Good seed of rutabagas is important and much good might be accomplished by local seed production from good roots.

Table XXIV shows results of a trial comparing station-grown seed from selected roots with the common commercial stock.

TABLE XXIV. COMPARISON OF YIELD IN TONS AN ACRE FROM SEED OF SELECT ROOTS AND COMMON COMMERCIAL SEED

Astoria, 1919

	tons
Station-selected seed	30.25
Common seed	26.45
Gain	3.80

Manure and superphosphate increase root yields. Rutabagas and turnip yields are economically increased by liberal use of barnyard manure and superphosphate. Heavy applications, usually at least 20 tons of manure and 400 or more pounds of superphosphate an acre, are necessary. Tables XXV and XXVI show the effect of fertilization on root yields.

TABLE XXV. EFFECT OF FERTILIZER AND MANURE ON YIELDS OF RUTABAGAS GROWN ON DIFFERENT LAND EACH YEAR

Astoria, 1918 and 1919

Treatment per acre	Yield an acre 1918	1919
	tons	*tons*
No manure	5.57	.....
Manure 20 tons	16.36	29.25
Manure 20 tons, superphosphate 400 lbs.	24.98	30.25
Manure 20 tons, superphosphate 800 lbs. (1918), 500 lbs. (1919)	25.75	31.52
Manure 20 tons, superphosphate 400 lbs., sulfate of potash 200 lbs.	.....	37.27

TABLE XXVI. EFFECT OF FERTILIZER ON TURNIPS AND RUTABAGAS GROWN ON MANURED UPLAND

Astoria, 1921

Treatment per acre	Yield an acre Pomeranian White Globe Turnips	Improved American Purple Top rutabagas
	tons	*tons*
Check, no treatment	21.17	20.12
Sulfur 200 lbs.	23.48	20.50
Superphosphate 500 lbs.	25.93	21.96
Superphosphate 1000 lbs.	27.40	33.95
Check, no treatment	18.25	19.83
Superphosphate 500 lbs., potassium chloride 200 lbs.	25.74	16.22
Check, no treatment	21.82	14.03

Cultural directions. Rutabagas should be planted late enough to avoid root maggot injury. Two to three pounds of seed an acre is sowed in 30- to 36-inch rows June 5 to 20. About a month after planting the rutabagas are thinned to single plants about 12 to 14 inches apart in the row. Delay makes thinning more difficult and reduces the yield. It is best to get the thinning done before time to make hay. Culture is similar to that of turnips.

Mangels or cow beets. Mangels are the most promising of the root crops for sections where the season is rather too dry for the late-planted rutabaga crop and where the root maggot causes serious loss. In the lower-rainfall sections mangels are usually best. They are high-grade feed for all classes of stock except breeding rams. Varietal results at Astoria are shown in Table XXVII.

TABLE XXVII. RESULTS OF MANGEL VARIETY TRIAL IN TONS AN ACRE ON MANURED UPLAND

Astoria, 1923

Variety	Number plots averaged	Roots	Tops	Total
		tons	*tons*	*tons*
Prize Winner	2	23.40	6.00	29.40
Mammoth Long Red	1	18.85	8.70	27.55
Giant Intermediate	2	17.01	6.88	23.89
Golden Tankard	2	15.54	7.74	23.28
Half Sugar	2	14.87	6.07	20.94

Mangel culture. Mangels should be planted in rows about 30 to 36 inches apart from mid April to the latter part of May. In the south Coast sections the earlier planting may be practiced. About eight pounds an acre of seed is used. The seed should be planted about one to two inches deep. Thinning to about 12 to 14 inches apart in the row should be done when the fourth leaf appears. Culture of mangels is similar to other roots. Mangels are more susceptible to freezing injury than rutabagas. They must be dug and stored for feeding purposes. Cool, dark, dry, well-ventilated storage, conveniently arranged to avoid excessive handling and lifting is desirable. Care should be taken to avoid unnecessary bruising of the roots in handling.

KALE

Kale is used in some sections of the Coast for cow feeding purposes, but root crops are generally considered more important.

SOILING CROPS

Any crop that is harvested and fed green is a soiling crop. The most common in the Coast sections are grasses and clovers, Japanese barnyard millet, small grains alone, corn, roots, or combinations of peas and oats, or vetch and oats. Summer soiling crops are most needed in July and August to supplement pasture.

Green feed keeps up production. Daily milk-production records for the Astoria Experiment Station herd over a period of three years show an average decrease in production of 25.8 percent for the last of August compared with the last of June. This decrease was also evident in butter-fat deliveries to the Lower Columbia Cooperative Dairy Association in 1923. The June deliveries were 104,869 pounds butter-fat; the

July, 98,810 pounds; the August, 84,892; and the September 72,418 pounds. Compared with June this represents a drop of 5.8 percent for July, 19.1 percent for August, and 31.0 percent for September.

The average of two years' production of the Astoria Station herd when the cows were fed soiling crops to supplement pasture shows a decrease of 16.2 percent for September 1 compared with July 1. These cows were on new pasture that contained abundance of clover.

Summer pasture needs supplemental feed. Pastures during the warm weather do not appear to be as palatable as in June. At least the cows do not consume enough to maintain maximum production even when pasturage is available. By the use of soiling crops with pasturage a dairyman may expect an increase of about ten percent over pasturage alone.

The aim in growing soiling crops should be to produce the maximum yield of nutritious, palatable feed per acre. Legume crops for green feed are preferable. High yield will prevent coarseness and waste, requires less land for a given number of cows, and requires less labor because of smaller area to cut each day. Large yields and a dense stand can be secured by heavy seeding and a liberal use of manure.

The labor cost of harvesting and feeding soiling crops is high. Low costs should be maintained. The crops may be fed to the individual cows while they are being milked, or hauled to the pasture, letting the cows eat off the rack. The latter does not favor the highest producing cows but it usually is the cheaper practice. Soiling crops should be grown as near as possible to the place of feeding to keep labor costs low.

Roots fed directly. Roots for winter feeding are handled directly from the field. Enough is hauled at one time for two or three days during fall and early winter. With the possibility of a cold-weather period, roots for ten days may be kept in the barn. The tops and roots are fed and both are good feed. The roots do not need to be cut for the cows, as they soon learn to eat the whole root. Mangels should be stored before November 15 to prevent a loss from freezing in the field. All roots are approximately of the same feeding value. Turnips and rutabagas must be fed after milking in order to prevent a taste in the milk or cream. Even as small an amount as fifteen pounds of roots will flavor milk if fed before milking. Fifty or more pounds a day will flavor the milk no matter when fed.

As the price of dairy products and the value of land advance and dairying becomes more intensive more soiling crops must be used.

Cropping system for soiling crop production. Table XXVIII gives complete information for a cropping system to provide soiling crops. The system given is based upon the results of experiments with many crops. It has been used satisfactorily in providing green feed for the station dairy herd. Table XXVIII is intended to serve as a guide in planting to produce green feed either for the entire year or for any part of the year. The feeding dates are approximate, and the area necessary to produce feed for ten cows is based upon average yields. The table will be of widest use for dairymen who are following an intensive dairying system. For extensive

TABLE XXVIII. CROPPING SYSTEM FOR GREEN FEED PRODUCTION ON HILL LAND

Crop and variety	Rate of planting	Date of planting	Fertilizer to acre	Feeding date	Acreage required for 10 cows
	lbs.				
Common vetch and Gray winter oats	60 50	Sept. 20 to October 20	10 tons manure	June 20-July 20	½ acre
Common vetch and Gray winter oats	60 50	Feb. 15 to March 15	10 tons manure	July 1-July 25	½ acre
Field peas and Gray winter oats	100 50	Feb. 15 to March 15	10 tons manure	July 1-July 20	⅜ acre
Field peas and Shadeland Climax oats	100 60	March 15 to April 10	10 tons manure	July 10-Aug. 1	½ acre
Japanese barnyard millet	25-30	May 1 to June 10	15 to 20 tons manure	Aug. 1-Sept. 10	¾ acre
Turnips Pomeranian White Globe or Imperial Green Globe	2-3	June 5 to June 15	15 to 20 tons manure, 400 lbs. superphosphate	Sept. 10-Nov. 1	½ acre
Rutabagas or mangels Improved American Purple Top or Skirvings Improved or Prizewinner Mangels	2-3 8-10	June 5 to June 20 May 15 to June 1	20 to 25 tons manure, 500 lbs. superphosphate	Nov. 1-March 20	1¾ acres

dairying part of the information will be of use to provide green feed for times when there is a shortage of pasture or to supplement silage. The whole or parts can be followed profitably by the dairyman of limited capital or the dairyman with a herd too small to warrant construction of a silo.

Better yields from tide-land and bottom-land. The table is prepared for hill land. It will apply to tide-land or bottom-land except that a larger yield can be expected and less manure will be required. For tide-land or bottom-land no manure need be used for vetches or peas as these crops will produce an average yield without manure. Under average conditions 3 to 3¼ acres will produce soiling crops for ten cows where they have the use of pasture.

SILAGE CROPS

Silage is desirable on the dairy farm to furnish a cheap source of succulence for summer or winter feed. It reduces the amount of hay required by about 40 percent. It keeps the cow in better condition than when roots are fed alone. Many crops may be successfully stored in a silo. The better the crop the better the silage. The more food value the crop contains the more the cow will receive when the silage is fed.

Peas and oats good silage. Corn is the standard silage crop of the United States. Corn is not grown extensively or successfully in the north Coast region. Unless a yield of ten tons or more per acre can be secured it will be found advantageous to grow other crops. Probably the best Coast silage crop is peas-and-oats.

Oats is the crop used now most extensively for silage purposes. If cut at the proper time it makes a good silage that is relished by the cows. Better and more palatable silage is secured if peas or vetch is grown with the oats. Considering yield and feeding value peas-and-oats and vetch-and-oats are more satisfactory than oats alone.

Silage making important. The most important factors in the production of good silage are maturity and packing. The proper maturity has been discussed under the crop. In producing good silage from small grains the finer the silage is cut the better it packs and the less tendency to mold. Two men should be in the silo tramping at all times. It is usually a good practice for the owner to be in the silo himself. Tramping rather than the use of water should be depended upon to remove the air. Water should be added particularly with hollow-stemmed silage or when the forage has dried out and wilted badly. Green or slightly wilted crops usually do not require water. The addition of surplus water results in poor silage. The silo may be topped out or sealed with waste materials, such as ferns, wild grasses, or sedges.

HAY CROPS

Legume hay best. The value of the hay crop depends on three things: the amount of legumes present, the stage of cutting, and the manner of curing. The importance of a large percentage of legumes has been discussed at some length. Too much importance can not be placed on the stage of cutting. Hay that has been allowed to become too ripe is similar to straw as most of the food value has passed into the seed. Fine stemmed, green, leafy hay is best.

Prompt curing necessary. Hay should be cured and hauled as soon as possible. Exposure for any length of time to either sun or rain very materially decreases its value. If it is impossible to haul immediately, allow it to cure in the shock. Care should be taken in handling of clover so as to prevent a loss of leaves. Good hay should have a green color and a pleasant odor.

PASTURE CROPS

More experiments needed. Pasture experiments at the Astoria Station have been limited, and the results of these trials together with observations and data secured from the various Coast counties are made the basis for the following discussion and recommendations.

Pasture important. The pasture crop of the Coast district is probably its most important forage crop. The large areas of rough land subject to washing, stump land with too great a clearing expense, poorly drained land, and some tide-land having too many buried logs and roots, are adapted, for the present at least, only to pasturing. Many acres of plow land in this Coast district of cool summers and frequent summer rains are now producing profitable pasture crops.

The climate and soil of the Coast district is generally better suited to the moisture-loving and acid-tolerant grasses and legumes. There is a tendency for Coast land pastures without lime or manure to become

pretty much occupied by acid-tolerant grasses, as Red Top and Creeping Bent grass.

Good grasses. Of the short-lived perennial grasses suited to pasture conditions, English rye-grass, Italian rye-grass, and timothy are productive and commonly used. English rye-grass is normally finer in growth and somewhat longer lived than the Italian rye-grass.

Kentucky blue-grass is not so good for the sour soils but does well on some of the well-drained bottom-lands. On the more sour hill soils and tide-land soils it should usually be replaced to a considerable extent with redtop, or creeping bent grass.

Orchard-grass should be included in all upland mixtures and may usually be advantageously used on both the bottom- and the tide-land types. It is especially good on fern land. Tall oat grass is most likely to be useful in mixtures on the dryer hill soils.

Meadow-foxtail is an early, long-lived, sod-forming perennial especially useful on tide-land or other moist, sour soils. Seed of meadow-foxtail is often of poor quality.

Reed canary-grass is a remarkably productive and valuable perennial grass suited to wet tide-lands and other bottom lands and is commonly grown for hay and pasture in the southwest Coast district. It is said that in old reed canary-grass meadows practically everything but reed canary-grass and creeping bent grass is crowded out.

Of the legumes for Coast land pasture white clover, Ladino white clover, and alsike seem best. Without lime and manure the tendency is for the legumes to be gradually eliminated from the pastures.

Starting pastures. Coast pastures are often started by burning over land in the early fall, then sowing the grass seed on the dry ashes as soon as they have cooled. This sowing should take place early, as in August or early September in sections where freezing and thawing is likely to take place. In districts where heaving caused by freezing and thawing is likely to happen, spring sowing is best. The seed bed should be rather fine and firm underneath. Owing to the variable quality of grass seed it is usually best to have the seed tested previous to preparing the mixture. Shallow sowing is necessary because of the small size of grass seed.

Pasture mixtures. Recommended pasture mixtures follow.

Hill Land

	lbs.
English rye-grass	5
Orchard-grass	4
Tall oat-grass	2
Timothy	3
Kentucky blue-grass	1
Redtop	1
Alsike clover	1
White clover	½
	17½

Sow at 16 to 25 pounds an acre depending on seed quality.

Bottom-land

English rye-grass	5
Orchard-grass	4
Tall oat-grass	2
Timothy	3
Kentucky blue-grass	3
White or Ladino clover	½
Red clover	3
	20½

Sow at 16 to 25 pounds an acre depending on quality of seed.

Well-drained Tide-land

English rye-grass	5
Orchard-grass	4
Timothy	3
Meadow-foxtail	4
Redtop	2
Alsike clover	2
White clover	1
	21

Sow at 18 to 25 pounds an acre.

Bottom- or Tide-land, Subject to High Water Table and Winter Overflow

Reed canary-grass	3
Creeping bent grass	2
Meadow-foxtail	4
Timothy	5
Alsike	2
	16

Sow at 16 pounds an acre.

Pasture management. The young grass should not be pastured until it is well established and stock should be kept off when the ground is soft. The pasture should be kept eaten off rather closely, but should not be fed off so closely as to expose the grass crowns or too greatly limit the leaf surface. Where the stock cannot keep the pasture eaten down, an occasional mowing is a good thing to keep the grass from becoming too coarse and to keep weeds in check. Pastures should be harrowed to scatter manure. Bare spots should be reseeded and care should be taken to keep out weeds and brush. Applications of barnyard manure from time to time will keep the growth more luxuriant and help to maintain the better grasses and prevent weeds. Applications of lime will help in the development of many of the grasses, and also maintain a better stand of the clovers. Weedy pastures in many cases must be plowed and reseeded. Productive palatable pasture is probably the cheapest forage in the Coast district.